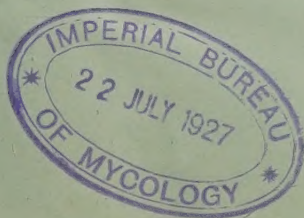


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FURTHER STUDIES OF THE BROWN-ROT FUNGI.

- II. A CONTRIBUTION TO OUR KNOWLEDGE OF THE
DISTRIBUTION OF THE SPECIES OF SCLEROTINIA
CAUSING BROWN-ROT.



Further Studies of the Brown-rot Fungi.

II. A Contribution to our Knowledge of the Distribution of the Species of *Sclerotinia* causing Brown-rot.

BY

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DURING the last ten years the writer has obtained from various sources abroad a number of specimens and cultures of the species of *Sclerotinia* causing the brown-rot diseases of fruit trees, in order to compare them with the fungi causing similar diseases in this country. The results obtained, though by no means exhaustive, may not be without interest to those who are studying these diseases, which are widespread and take a heavy toll of the world's fruit crop each year.

Since Woronin's paper of 1900 (40) appeared, it has been generally recognized that there are, in Europe, two species of fungi commonly associated with the brown-rot diseases, viz. *Sclerotinia fructigena* and *S. cinerea*. These two species are rife on the Continent, and both are of common occurrence in this country. The status of *S. laxa* has been discussed in a previous paper (36); morphologically and culturally this fungus of the apricot was found to be similar to *S. cinerea*, and there is no clear evidence at present that it is different biologically from the latter. This conclusion is supported by Chabrolin (4), who has made detailed observations on brown-rot of apricots in the Rhone Valley. In the present paper, therefore, *S. laxa* is considered as synonymous with *S. cinerea*. Two other species of *Sclerotinia* (related to *S. fructigena* and *S. cinerea*, but readily distinguished from these by the presence of disjunctors between the conidia) found on cultivated fruits, viz. *S. Mespili* and *S. Cydoniae*, are known on the Continent, and have been recorded for this country (38, 39); they are of minor importance economically, and will not be considered further in this paper.

The biology and parasitism of the two common brown-rot fungi, as related to diseases of fruit trees in this country, have been described in previous articles (31-7), and the chief points only will be recapitulated here.

S. fructigena is the commonest cause of fruit-rot in ripening apples, pears, and quinces, and it is also frequently found on plums and cherries. *S. cinerea* is not only a common cause of fruit-rot, particularly in plums and cherries, but it also infects the flowers, causing 'blossom-wilt', and in plums infects the leaves and young shoots (33, 37).¹

It has been shown (34, 35) that *S. cinerea* is represented in this country by two biologic forms, one which causes a blossom-wilt and canker of apple trees, and another which infects the fruit and flowers of plum and cherry trees.² The apple blossom-wilt fungus *Sclerotinia cinerea forma mali* has been studied chiefly in relation to serious outbreaks of the disease in the southern counties of England (31), but it has also been isolated by the writer from apple spurs received from Scotland and from Ireland. *S. cinerea* f. *pruni* is also generally distributed in those parts of the British Isles where plums and cherries are grown.

Another brown-rot fungus, not recorded for this country, is that prevalent in the United States. In the morphology of its ascigerous and conidial fructifications it is clearly closely related to *S. cinerea*, and in American plant-pathological literature it is generally given that name. It was formerly referred to as *S. fructigena*, but recent workers, as Matheny (18), Conel (5), Valteau (29), and Bartram (3), consider this name was given in error, as there is no good evidence that *S. fructigena* has ever been found in America, even in its conidial stage.

A brown-rot fungus discovered in Pennsylvania in 1883 was named by Winter (30) *Ciboria fructicola*; this name, however, according to Ezekiel (11), 'cannot be assigned to any of the species now known, since the description does not differentiate between them'.

In 1917 the present writer (31) pointed out that this common American brown-rot fungus could be distinguished in cultures from the European forms of *S. cinerea*. Its habit of growth on agar media was different, and it produced conidia freely on such media under conditions which completely suppressed conidia production in the European fungus. A difference could also be observed in the mode of branching of the germ tube of the conidium. For convenience this fungus was later (35) referred to as *S. cinerea* f. *americana*. Recently certain American workers have studied this side of the problem. Norton and Ezekiel (22) consider the differences are sufficient to raise the American form to specific rank, and suggest the name *Sclerotinia americana*, (Wormald) Norton and Ezekiel. Roberts and Dunegan (24), however, maintain that this conclusion is untenable, for, although they offer confirmation of the fact that cultural differences are to

¹ Both fungi have been found occasionally on hosts other than those here mentioned; this point will be dealt with in a future article.

² Killian (16, 17) finds that on the Continent the form of *S. cinerea* on acid cherries is biologically different from the form on sweet cherries.

be recognized, they consider them insufficient (in the absence of any evidence that the American form is distinct from *S. cinerea* morphologically, except in the mode of branching of the germ-tube) to warrant the adoption of another name. One argument used by Roberts and Dunegan against the use of a distinguishing name for the American form is that, with successive sub-culturing, this fungus loses one of its characteristic features, that of free sporing. The fact remains, however, that, when freshly isolated, the fungus invariably produces conidia readily on agar plates or slopes; a single conidium isolated on a prune-agar plate will germinate and give rise to mycelium bearing tufts of conidial chains within four or five days.

Ezekiel, in a more recent paper (11), records the occurrence of the European *Sclerotinia cinerea* in certain parts of America, and restates his claim for the use of the name *Sclerotinia americana* for the more common form found in North America. He has made a comparative study of the two fungi and finds that they can readily be distinguished, not only in the more prolific production of conidia by *S. americana*, but also by their habit and rate of growth on various culture media, and in the mode of branching of the germ-tube and of the hyphae. He also considers that in their mode of parasitism the two fungi are not identical, and concludes that 'the species (*S. cinerea* and *S. americana*) thus not only differ morphologically and physiologically, but their effect on the host appears sufficiently distinct to necessitate separate treatment from a pathological view-point'.

Should further investigation confirm Ezekiel's conclusions with regard to their parasitism (and observations made by Barss (2) go in the same direction), then plant pathologists must recognize them as at least different forms, and they must be studied with a view to restricting their distribution to the regions where they are found already.

In the following discussion the present writer adopts the name *Sclerotinia americana*, as proposed by Norton and Ezekiel, when referring to the common brown-rot fungus of North America.

The areas from which cultures or specimens have been received, with an account of the results obtained from comparing and identifying the fungi in pure cultures, are as follows:

The Continent of Europe. The studies of Woronin (40), Aderhold and Ruhland (1), Frank and Krüger (12), Sorauer (26), and many others show that *S. fructigena* and *S. cinerea* are common and very destructive on the Continent. From a comparison of over twenty strains¹ received from Holland, France, Italy, Switzerland, and Russia (either as cultures or as specimens from which cultures were obtained), it is found that the two common forms which occur in Britain are identical with the Continental

¹ By 'strain' is here meant a pure line; any one strain may or may not be distinguishable culturally from others.

species. In culture the various European strains show slight variations among themselves, and the same is true of strains occurring in Britain; thus, with regard to both *S. fructigena* and *S. cinerea*, when grown on prune juice agar, some strains remain colourless, while others develop a brown coloration in varying degrees.

The fungus causing blossom-wilt and brown-rot canker of apple trees in this country, *S. cinerea* f. *mali*, is probably present on the Continent, since Eriksson (10) has described a disease of apple trees in Sweden with similar symptoms. Eriksson refers to the fungus as *S. fructigena*, but from his description it is evidently *S. cinerea*, and probably therefore f. *mali*. The writer had not yet been able to obtain a specimen or culture of *S. cinerea* f. *mali* from abroad.

One culture, received from Dr. Westerdijk of the Centraal-bureau voor Schimmelcultures, Holland, proved to be indistinguishable from *S. americana*. This result was unexpected and inquiries were therefore made as to its origin. Dr. Westerdijk supplied the information that the strain was isolated from an apple (variety Prince Bismarck) in Holland. As this would appear to be the only occasion that this species has been isolated from European specimens its further distribution in Europe is not known. If this fungus is really a native of Europe, and the specimen from which it was isolated was the result of a natural infection in the open, it is surprising that the fungus is not more generally distributed in Europe, for in other parts of the world (mentioned below) in which it has been found it is very prevalent and most destructive.

The United States. From 1915 to 1924 the writer examined in all twenty-one strains isolated from specimens found in the United States; these were supplemented in 1925 by a set of twenty-five cultures received from Prof. H. P. Barss.

From 1915 to 1919 nine strains were obtained from apple, peach, and plum grown in the States of Oregon, Wisconsin, Virginia, New York, and North Carolina. From the study of these it was first realized that the common brown-rot fungus of America was not identical with either *S. fructigena* or *S. cinerea* as found in Europe, and to distinguish it this form was referred to as *S. cinerea* f. *americana*. As mentioned above this form has been raised by Norton and Ezekiel to specific rank as *S. americana*.

In 1920 Dr. W. L. Howard sent, from California, mummied fruits of peach and apricot, and an apricot twig. Isolations from these proved to be identical, not with the typical American form, but with the common form of *S. cinerea* found on stone-fruits in Britain and on the Continent.¹ In the following year further samples of mummied apricots and peaches were

¹ These results, not published at the time, were held over for incorporation in the present paper. In the meantime the same conclusion was arrived at by Ezekiel (11), who published his results in 1924.

received from California; the fungus present in them was again found to be *S. cinerea* f. *pruni*. About the same time (February, 1921) peach mummies, sent from Kentucky, were examined and the fungus in these, in contrast with the Californian specimens, proved to be *S. americana*. During 1922-4 specimens and cultures received from the States of Washington, New York, Maryland, and Virginia were also *S. americana*, but a culture obtained from California in 1924 again proved to be *S. cinerea* f. *pruni*.

A fungus causing disease in pears, apples, and various stone-fruits in the coastal regions of Oregon, has been studied by Jackson (14), Posey (23), and Barss (2). It was recognized by them as distinct from the common brown-rot fungus of America, and since the latter at that time was generally considered by American plant pathologists to be identical with *S. cinerea*, the Oregon fungus was thought to be a form not previously described, and the name *Sclerotinia oregonensis*, Barss and Posey, was proposed for it. Ezekiel's work (11), however, suggested that *S. oregonensis* might be identical with *S. cinerea* f. *pruni*. Professor Barss therefore sent to the writer a number of his cultures. Six of these (labelled as *S. cinerea*) were seen to be the common American form, *S. americana*; the rest (referred to as *S. oregonensis*) isolated from various hosts, e.g. pear, apple, plum, peach, apricot, were indistinguishable in cultures from *S. cinerea* f. *pruni*.

The conclusion to be drawn from the evidence available therefore is, that, in the Pacific coastal regions of the United States, *S. cinerea* f. *pruni* (the form of *S. cinerea* found on stone-fruit trees in Europe) is the brown-rot fungus commonly met with, while in the rest of the States *Sclerotinia americana* prevails.

The numerous papers which have been written by American workers on the biology and control of the brown-rot diseases testify to the enormous damage caused by these diseases in the United States. References to the more important of these papers up to 1925 will be found in a recent article by Rudolph (25).

British North America. In 1916 a number of mummied plums and peaches were received from Mr. W. A. McCubbin, who had collected the specimens in Ontario. Isolations were made from these, and the fungus was found to be the common American form, *Sclerotinia americana*. Shortly afterwards Mr. McCubbin found an ascigerous stage on plums and peaches, and cultures prepared from ascospores were also sent over for comparison with the other strains. These again proved to be *S. americana*.

More recently (in September, 1925) plums were received from the Fraser Valley, British Columbia, sent by Mr. J. W. Eastham. The specimens were fruit of that year's crop (not yet mummified when received), and they arrived in a rather pulpy condition. On placing particles of the flesh on prune-agar plates, however, a fungus grew out; its mode of growth

and production of conidia within a few days soon proclaimed it also to be *S. americana*. In the letter accompanying the specimens Mr. Eastham stated that in Vancouver Island a brown-rot fungus believed to be Barss's *S. oregonensis* occurred. With regard to the damage caused by the two fungi he remarked, 'The rot which has been sent you occasions a certain amount of twig blighting, but we have had no complaints of any serious blossom injury. The *oregonensis* appears to occur chiefly at the southern extremity of Vancouver Island, and its economic effects are almost entirely confined to a very extensive blossom blight of Olivet cherries, though sweet cherries and plums also suffer to a less degree.' Included in Professor Barss's collection of cultures of *S. oregonensis* (referred to above) were two strains isolated from cherries collected in Vancouver Island; these, in common with the other strains included under that name, were found to correspond to *S. cinerea* f. *pruni*, and there can be no doubt, therefore, that this fungus also occurs in Vancouver Island.

The distribution of the two fungi *S. americana* and *S. cinerea* in British North America thus corresponds to that in the United States. The commoner form is *S. americana*, but in the south of Vancouver Island *S. cinerea* is found.

That these fungi are responsible for considerable damage to the stone-fruit crops in British North America is shown by the work of McCubbin (20) and Eastham and Ruhmann (9).

Australia. The fungus generally associated with the brown-rot diseases in Australia has, until recently, been referred to as *Monilia fructigena*. Thus in 1902 McAlpine (19) uses that name in describing brown-rot damage to apricots, peaches, and cherries in Victoria and South Australia. That the organism observed by McAlpine was not, however, *Monilia fructigena*, but a fungus with grey conidial fructifications, is shown by his descriptions, for he writes, 'The rotting of the fruit is the most striking symptom, with the ash-coloured spores produced on the surface', and again, 'Conidia are produced at the surface in such countless numbers as to give the portion attacked an ashy-grey appearance'. Such descriptions suggest that the fungus was either *Sclerotinia cinerea* or *S. americana*.

In 1922 Harrison (13) described 'the perfect stage of a *Sclerotinia* causing brown-rot of fruit' in New South Wales. He remarked that 'the organism is probably *Sclerotinia fructigena*'. This conclusion appears to have been arrived at in error by comparing the fungus with a strain wrongly named. Mr. W. L. Waterhouse later, in a letter to the writer, says, 'Mr. Harrison is now satisfied that the ascigerous strain he has is *S. cinerea*. The culture obtained from America and labelled *S. fructigena* is quite certainly wrongly named.' It is not clear, however, whether any distinction was made between *S. cinerea* and *S. americana*.

Previous to the publication of Harrison's paper Mr. Waterhouse had

sent to the writer, in 1921, mummied fruits of peach, nectarine, and Japanese plum. Cultures isolated from these showed that the fungus present was identical with the American form *S. americana*. In the following year Mr. Waterhouse sent a culture from an apple, and ascosporic cultures from plum and apple. These again proved to be *S. americana*, and cultures isolated from peach twigs sent by Mr. C. C. Brittlebank¹ from Victoria were also *S. americana*.

The brown-rot fungus generally distributed in the fruit-growing regions of Australia would appear therefore to be *S. americana*. The occurrence of either *S. cinerea* or *S. fructigena* in that continent is at present doubtful. Of the latter species Mr. Waterhouse in October, 1922, wrote,² 'We have not yet got it'.

New Zealand. The conidial stage of a brown-rot fungus, referred to at the time as *Sclerotinia fructigena*, was first recorded for New Zealand by Kirk (15) in 1905. An ascigerous stage was found by Cunningham (6) in 1922. In a recent work Cunningham (7) describes the brown-rot diseases in New Zealand, and refers to the fungus causing the damage as *Sclerotinia cinerea*, Schroeter. He quotes, however, *Sclerotinia americana*, Norton and Ezekiel, as a synonym without distinguishing between the two. Cunningham states emphatically that 'In New Zealand *S. fructigena* does not occur'.

In 1921 the writer examined material sent to him from New Zealand by Dr. K. M. Curtis. The specimens included apricot, peach, and plum mummies and peach twigs. Isolations were made from these, and in every case they gave rise to cultures of *S. americana*. This species is probably, therefore, the fungus responsible for the greater part, if not the whole, of the brown-rot damage in New Zealand. There is no evidence at present that either *S. fructigena* or *S. cinerea* (in its restricted sense as used in this paper) is present in that country.

South Africa. Brown-rot diseases have been recorded for South Africa by Doidge (8); the fungus was quoted as *Sclerotinia fructigena*, but no evidence was given as to its identity with that species. Brown-rot is apparently seldom met with in the fruit-growing regions of South Africa, doubtless as a result of the dry climate, and the writer has not yet succeeded in obtaining specimens, although requests have been made to several observers. All agree that the diseases rarely occur and specimens are difficult to obtain. In the article referred to above Dr. Doidge writes, 'Happily South African conditions do not seem favourable to the fungus causing the disease, and it is only in exceptionally wet seasons that it has been noticed as causing any appreciable damage'.

¹ In the letter accompanying his cultures Mr. Brittlebank wrote, 'The Brown Rot is, under certain conditions, one of our worst orchard diseases. A few years ago it took every fruit in an orchard which had at least 25,000 bushel cases of late peaches.'

² In correspondence.

Japan and Manchuria. In 1911 Takahashi published an account of the 'Sclerotinia diseases of Rosaceous fruit trees in Japan'. He describes a cherry disease caused by *S. Kusanoi* and a 'blossom blight of the apple'. The symptoms of the latter bear some resemblance to those of the 'blossom-wilt' of apples in Britain, but the conidia of the fungus are stated to be provided with disjunctors, which thus distinguish it from any form of *S. cinerea*. These two diseases appear to be unrecorded elsewhere.

In that author's *résumé* (28) of his original Japanese paper he writes: '*Sclerotinia cinerea* occurs in Hokkaido on the blossoms of apricot, *Prunus Mume*, and *P. tormentosa*, and on the fruits of cherry and apricot. *S. fructigena* is quite common in Japan on the fruits of apple and pear. It also appears on the ripe fruits of quince, cherry, apricot, peach, plum, *Prunus Mume*, *P. Pseudo-Cerasus*, grape, and *Elaeagnus macrophylla*'.

The present writer has not yet obtained brown-rot material direct from Japan, but he was able, on the advice of Dr. Takewo Hemmi, to get in touch with Mr. Michiya Miura, the pathologist attached to the Agricultural Experiment Station in South Manchuria, who sent over five cultures of brown-rot fungi labelled:

1. *Monilia fructigena*, peach fruit, Japan.
2. *Monilia fructigena*, pear-fruit, South Manchuria.
3. *Monilia laxa*, cherry, South Manchuria.
4. *Monilia laxa*, Chinese plum, South Manchuria.
5. *Monilia Kenjiana*, n. sp., apple fruit, South Manchuria.

The two strains of *M. fructigena* were similar to the European strains in their general habit of growth on agar plates and on sterilized potato, on the former growing out uniformly to the edge of the plate without producing conidia, and on the latter forming tufts of yellow conidiophores and conidia. The Japanese strain (No. 1) however produced, in several trials, a zone of black sclerotia towards the edge of prune-agar plates, a feature that has not been observed in any other strain of *S. fructigena*.

The two strains named *Monilia laxa* behaved as strains of *S. cinerea* from other sources in not producing conidia on prune-agar plates but developing grey conidial tufts readily on transferring to sterilized potato. The habit of these two strains on prune-agar plates was somewhat different from other strains of *S. cinerea* in growing out more regularly and in producing short scattered aerial hyphae, giving the culture a pilose appearance. There seems to be no reason at present why they should not be included under *S. cinerea*, which does include strains showing slight cultural differences as already mentioned.

The fifth strain is unlike any other strain of the brown-rot fungi studied by the writer; in his hands it has not produced conidia even on sterilized potato.

DISCUSSION.

Until comparatively recently it had been customary to designate as *Monilia* (*Sclerotinia*) *fructigena* any brown-rot fungus met with, but it is now recognized that there are at least four different brown-rot fungi (either species or biologic forms), each of which is responsible for considerable damage to the world's fruit crop. These fungi differ, not only in their habit when grown in pure cultures on prepared media, but also in their mode of parasitism. From the point of view of the plant pathologist (and ultimately that of the fruit-grower also) they must therefore be considered as entities, and their distribution must be studied with a view to guarding against the introduction of one or another into territories where it is not at present found.

So far as the evidence goes it would appear that *Sclerotinia fructigena* is absent from the great fruit-exporting regions of North America, Australia, and New Zealand. In Europe this is the fungus *par excellence* responsible for the rotting of apples and pears as they approach maturity on the tree and in the early stages of storage. It is not uncommon to see, in autumn, the ground under the trees strewn with fruit in various degrees of infection and many of them covered with the ochre-yellow *Monilia* fructifications. Again, apples infected with *S. fructigena* about the time they are put into the store may show no noticeable sign of infection, but after some time they become quite black and leathery, often with no trace of the fungus on the surface but with the flesh permeated with fungal hyphae. This type of 'black-rot' has been studied on the Continent, chiefly by Molz (21), and in this country by Spinks (27). Both attribute this disease to *S. fructigena*, and the writer (32), too, has invariably isolated this fungus from naturally infected black apples¹ except in the case of two apples sent to him from Oregon; the latter were infected with *S. americana*. In countries where *S. americana* is prevalent and *S. fructigena* absent apples appear to suffer little from brown-rot diseases. If, however, *S. fructigena* became established in the three regions mentioned it is conceivable that it would have an adverse effect not only on the growing apple crop but also on the fruit during transport.

In Britain apple blossom-wilt, caused by *S. cinerea* f. *mali*, is at times very destructive to certain varieties of apples, destroying the inflorescences, causing cankers, and killing back branches. There is no evidence that this disease is present in the chief apple-growing countries outside Europe.²

¹ The writer recently obtained through the courtesy of Dr. G. H. Pethybridge a black apple found at Covent Garden in a consignment of apples imported from Russia; particles of the flesh placed on agar plates yielded cultures of *S. fructigena*.

² Ezekiel (11) however finds that two of his strains of *S. cinerea*, isolated from stored apples at Washington, D.C., show certain cultural features in common with f. *mali*.

With the single exception of its discovery in Holland (already referred to) *S. americana* is unknown in Europe. Whether this fungus would be as destructive here as in those countries where it is present already cannot be foretold, but its introduction is most undesirable. The introduction to Europe of certain American parasitic fungi, e.g. American Gooseberry Mildew (*Sphaerotheca mors-uvae*) and the Downy Mildew of the vine (*Plasmopara viticola*), has been disastrous.

Since both *S. cinerea* and *S. americana* are found in the west of North America an opportunity is presented for a careful comparative study of the two, particularly with respect to their parasitism and their morphology. Experimental work in the open with the American fungus cannot be carried out in Europe without running the risk of introducing a new parasite, but this objection does not hold in the western States and in British Columbia, and it is highly probable that further comparative tests and field observations will be carried out now that it is known that both these fungi occur there. This side of the problem has already been approached by Ezekiel (11). Certain morphological points need further elucidation. Hitherto it has not been possible to study fresh material of the ascophores of the two species side by side, for although the ascigerous stage of *S. americana* has been found on many occasions and in great quantity in America, Australia, and New Zealand, this stage of *S. cinerea* has been found very rarely and never under conditions when a direct comparison with fresh ascophores of *S. americana* could be made. Another feature with regard to the morphology of the two species, which might well repay investigation from the systematist's standpoint, is the size of the conidia produced in winter and spring on the fruit, spurs, and shoots infected the previous season. *S. cinerea* f. *pruni* and f. *mali* under these conditions produce conidia considerably smaller than those found on the fruit or flowers during the spring and summer of the year of infection. Whether this also obtains with *S. americana* appears not to be mentioned by American observers. Material examined by the writer, though not yielding conclusive evidence on this point, suggests, however, that there may be a difference here. In this country it has been found (35) that the winter conidia of *S. cinerea* have an average size of about $11.5 \times 8 \mu$, while the summer conidia average about $18 \times 13 \mu$. The dimensions of conidia on mummied fruit received from America were obtained in those cases where the mummies arrived with viable conidia in sufficient numbers for obtaining representative measurements; in the following, 100 conidia were measured in each. The species of fungus isolated in each case, as determined later culturally, is stated.

It will be seen that the Californian specimens (infected with *S. cinerea*) bore conidia of a size corresponding to the winter conidia of *S. cinerea* in England. The conidia on the other specimens, infected with *S. americana*, were appreciably larger both in range and in average size. Whether such

differences are shown on mummies of the two species when examined immediately after removal from the tree can only be determined on the spot.

Fruit Mummy.	Source.	Date when examined.	Species of Fungus present.	Dimensions of Conidia.	
				Range of Size.	Average Size.
Peach	Ontario	April 4	<i>S. americana</i>	9 × 7·5–22 × 16	16·5 × 12·2
Plum	"	April 11	<i>S. americana</i>	11 × 8·5–24·5 × 19	17·2 × 12·3
Peach	Virginia	April 8	<i>S. americana</i>	10 × 8–18·5 × 11·5	14·4 × 9·8
Apricot	California	Feb. 29	<i>S. cinerea</i>	6 × 5–15 × 10	11·4 × 7·8
Peach	"	Mar. 1	<i>S. cinerea</i>	6 × 4·5–16 × 10·5	11·5 × 7·9
Peach	Kentucky	Mar. 3	<i>S. americana</i>	8 × 6·5–18 × 14	13·6 × 9·1

SUMMARY.

The present distribution of the common brown-rot fungi, so far as has been ascertained from the literature on the subject and a study of strains collected by the writer, is as follows:

Sclerotinia fructigena: Europe, Japan, Manchuria.

Sclerotinia cinerea f. *pruni*: Europe, the Pacific coast of North America, Manchuria, and (according to Takahashi) a form of *S. cinerea* occurs on various species of *Prunus* in Japan.

Sclerotinia cinerea f. *mali*: Great Britain and Ireland (and probably the Continent).

Sclerotinia americana: the United States, British North America, Australia, and New Zealand.

The economic significance of this distribution is discussed.

In conclusion the writer desires to express his indebtedness to all those plant pathologists who have given most willing assistance in this investigation by sending him specimens or cultures.

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